

LEO Propagation Measurement & Analysis

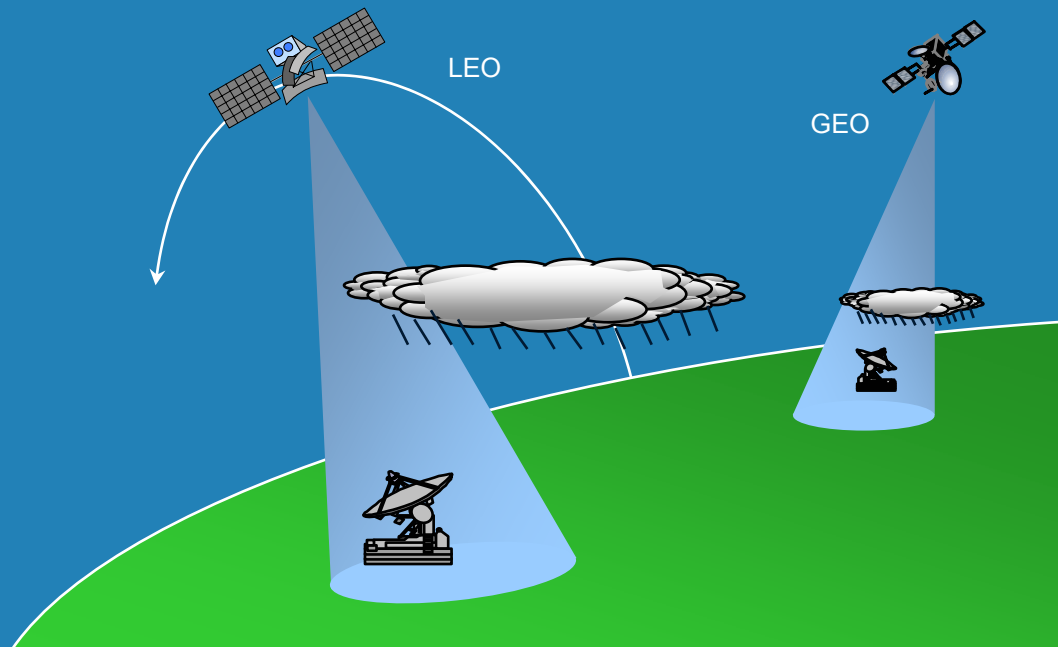
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LEO Propagation Measurement & Analysis

Overall Objectives

- Develop and evaluate LEO propagation models that will enable communication system designers to reduce the uncertainty of Ka-Band system availability predictions. This reduction in uncertainty will enable NASA, DOD and commercial mission planners to reduce mission cost by not over-designing the communication network system link margins.





GEO & LEO Propagation Experiment Collaborators

University of Puerto Rico (GEO)

- The University of Puerto Rico will host LEO Propagation Experiment terminal data collection and support.

Florida Atlantic University (GEO)

- Florida Atlantic University will provide software engineering support for terminal and propagation expertise for the LEO Propagation Experiment.

DoD/DISA and Global Broadcasting System (GEO)

- Users of NASA propagation data and models, interested in site diversity as mitigation technique

Italian Space Agency (LEO)

- Provides the DAVID satellite and Ka-Band satellite beacon at no cost to NASA for the LEO Propagation Experiment.



Current - GEO Propagation Measurement and Analysis

Description and Objectives

- Enhance the database that was acquired by ACTS in Ka-Band frequency spectrum in non-tropical regions by adding tropical data at Ka-Band.
- Determine service availability supplied to the end users and to predict the behavior of these systems when affected by high rain fading conditions.
- Evaluate and characterize RF propagation effects from GEO using microwave propagation terminals at Ka-Band
- Improve the accuracy of ITU-R prediction models by increasing the zones where propagation data is collected

Approach

- Modify reutilized ACTS propagation terminal hardware to enable GEO reception of beacons from DOD Global Broadcast Satellite (GBS) spacecraft
- Prepare for data collection by modifying ACTS propagation measurement techniques and experiment plans
- Disseminate information through technical reports and conferences

GEO Propagation Measurement Experiment Started May 2002



**University of Puerto Rico, Humacao PR
Ka-Band Propagation Site**



LEO Propagation Measurement and Analysis

Description and Objectives

- Develop a LEO propagation terminal to enable future characterization and modeling of the effect of rapidly varying atmospheric conditions on Ka-Band signal transmission from LEO spacecraft to ground
- Develop first-ever, world-class LEO propagation measurement techniques and experiment plan in collaboration with international partners

Approach

- Modify ACTS propagation terminal hardware to enable LEO tracking and reception of beacons from Italian Space Agency's Ka-Band DAVID spacecraft
- Prepare for data collection by modifying ACTS propagation measurement techniques and experiment plans
- Disseminate information through technical reports and conferences

LEO Propagation Measurement Rationale

Current State of the Art

- No LEO attenuation prediction models or data are available to NASA.

Planned Advances

- Understand the dynamic effects of the Earth's atmosphere on rapidly changing Ka-Band transmission from LEO spacecraft as it traverses the sky.
- Provide Ka-Band system designers with tools necessary to efficiently design high-speed, wide bandwidth LEO communications downlinks that needed by the near-Earth space enterprises to distribute data effectively from NASA spacecraft and deliver “fiber-like” signal quality and data rates.

Benefits and Approach

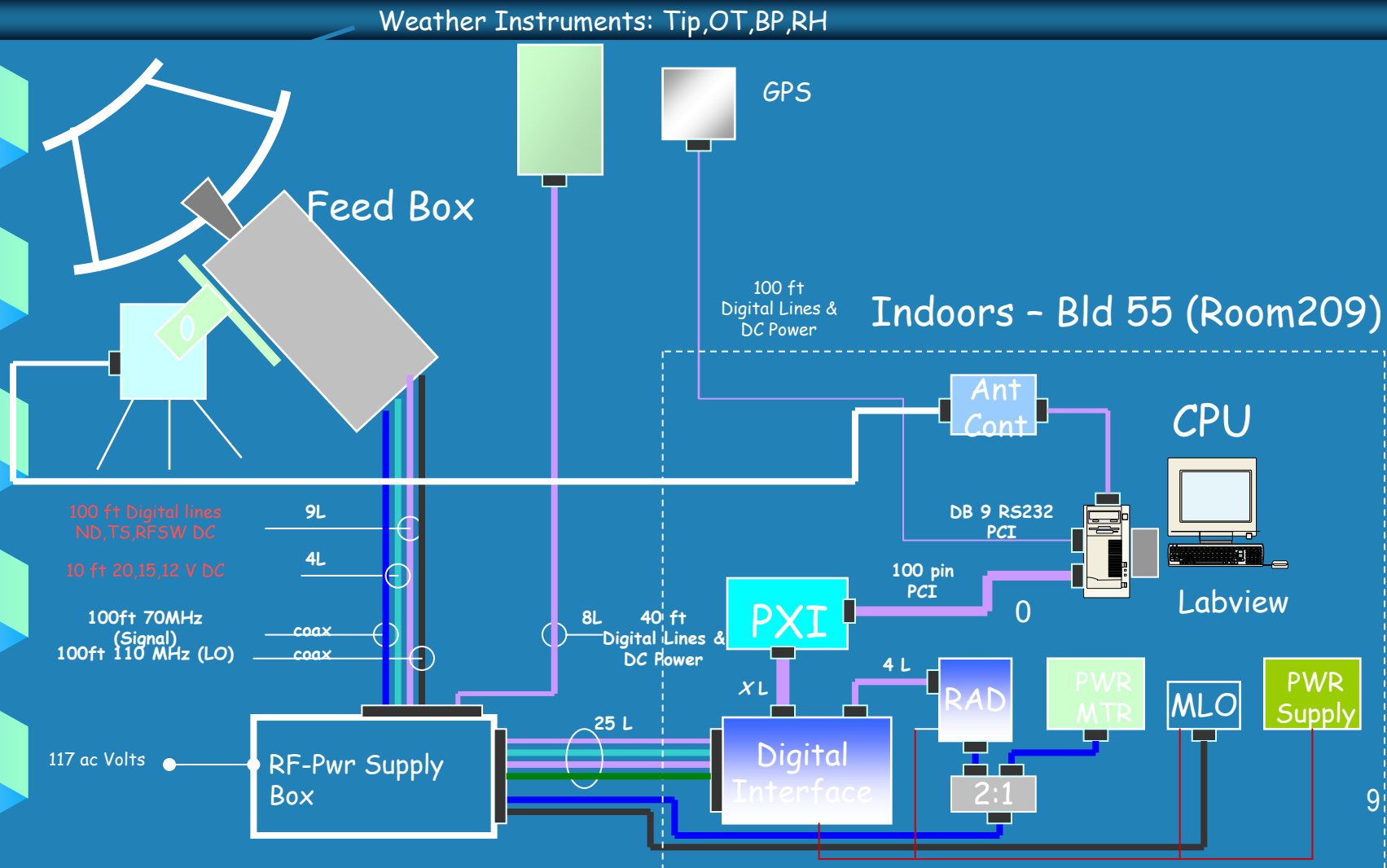
- Ka-band transmission from LEO spacecraft offers increased bandwidth and reduced size and cost of tracking terminal antennas compared to systems operating in X-Band.
- Ka-Band LEO propagation models will enable communication system designers to improve the accuracy of system availability models without over-designing the communication network system link margins.
- Ka-Band LEO service availability models will be supplied to the end users to predict the behavior of these systems when affected by high rain fading conditions.

LEO Propagation Measurement Experiment Status



GRC LEO Tracking Terminal Hardware

LEO Propagation Measurement Experiment Status



Radiometer Derived Attenuation



For low fades (< 7dB) there is 1:1 correlation with co-pol attenuation

LEO Propagation Measurement Status and Plans

FY02 Status - Completed

- Purchased for evaluation, a prototype weatherized LEO propagation terminal that includes tracking system hardware and data collection control program software.
- Initiated a Ka-Band LEO propagation experiment planning activity with the Italian Space Agency for use of their DAVID LEO spacecraft.
- Began development of system availability models that will be used as a standard by NASA and commercial mission planners.
- Develop a fully operational propagation terminal by end of Q4FY02
- Conduct experiment design review meeting scheduled with the Italian Space Agency for September 22, 2002.

FY03 Current Status

- Complete Integration of a LEO Tracking terminal by May 03
- Start Radiometer data collection medium rain zone and tracking the ISS or IRIDIUM Spacecraft's
- Plan and design Ka-Band LEO propagation experiment with DAVID satellite and disseminate information through appropriate technical reports and conferences¹⁴ by end of Q1FY03.